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Interactive comment on "Quantifying nutrient fluxes in Hyporheic Zones with a new Passive Flux Meter (HPFM)" *by* Julia Vanessa Kunz et al.

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Dear John Selker, thank you very much for the comments to our article!

Your comment encouraged us to revise our manuscript. Please see the updated version in the supplement of this response.

Also see below the remarks to your questions/comments.

We admit that the temperature profiling was not adequately accounted for in our article. In response to your remark on p 12, line 9 ("I seem to have missed the comparison to the heat/temperature profile method"): Direct comparison between fluxes detected in the HPFM and those derived from temperature profiles is not possible, because the temperature profile assesses vertical (here dominantly downwards) flow while the

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Discussion paper

HPFM assess HORIZONTAL flow. We provide a quotient of both from which we calculate an angle of hyporheic flow. Vertical flux was measured in this study in order to supplement our measurements, not as a comparative measurement of flux assessed in the HPFM. We tried to conduct the heat pulse method describe for example by Lewandowski et al. [2011], which can be used to measure small scale hyporheic flow velocities and directions. This method worked well to investigate small scale spatial heterogeneity of hyporheic flow in the shallow (< 10cm) layer of sandy stream beds. However, the gravel at our study site was too coarse, so that installation of the instrument was not practicable. Lewandowski, J., L. Angermann, G. Nützmann, and J. H. Fleckenstein (2011), A heat pulses technique for the determination of small-scale flow directions and flow velocities in the streambed pof sand-bed streams, Hydrological processes, 25.

Page and lines statements in the following text are referring to the revised article! We added several lines on temperature profiling as used in this study to the intro, also highlighting the differences to the Darcy fluxes derived from HPFM measurements. p.4, line 2ff High resolution vertical temperature profiles have efficiently been used to derive vertical Darcy velocity (qy) (m d-1) in the streambed. This methods is based on time series measurements of temperature in the stream and in the sediments at several depths. Based on a numerical model vertical flow velocities can then be calculated from the measured attenuation and phase shift of the diurnal temperature signal which, at depth, varies with the vertical hyporheic flux [Keery et al., 2007; Schmidt et al., 2014] While those vertical Darcy velocities measurements are a valuable supplement, horizontal fluxes are also needed in order to assess hyporheic transport and residence time.

Likewise, the section describing the method in the method-parts was supplemented. p.9, line 29 A numerical solution of the heat flow equation was then used in conjunction with Dynamic Harmonic Regression signal processing techniques for the analysis of these temperature time series. The coded model was kindly provided by the authors of the above mentioned study. We used vertical Darcy velocities qy to supplement horizontal fluxes assessed with the HPFM in order to estimate the general direction of flow (upwards or downwards) and to calculate the angle of hyporheic flow.

A sentence was added to the results, underlining the differences between qx and qy p12, line 3 With this, vertical flow qy was slightly lower than average horizontal flow qx.

And finally we discussed the usage of temperature profiling in hyporheic studies p14, line 24 Highly resolved temperature profiles enabled us to derive vertical velocities of hyporheic zone. Temperature loggers deliver continuous data, which allow estimating vertical Darcy flux for longer time periods. We therefore consider this method an ideal supplement to the horizontal fluxes assessed with the HPFM. At our study site, vertical water movement was constantly downward and the lowest concentrations of NO3- were observed in the deepest segments of the HPFMs, thus the hyporheic zone at this study site likely extends deeper than the 50 cm evaluated. Addressing your further remarks, we now listed all citation chronologically and corrected the grammatical errors you noted. We added a few lines to the introduction emphasizing the importance of the hyporheic zone. p. 2, line 15 Hyporheic zone processes can substantially modify surface water chemistry during propagation through river networks [Harvey et al., 2013; Boano et al., 2014]. Naegeli and Uehlinger [1997] estimated that the hyporheic zone contributed between 76 and 96% to whole ecosystem respiration. Other studies documented a wider range of hyporheic contribution to whole stream respiration, e.g. 40 to 93 % [Fellows et al., 2001], but agreeing on the importance of hyporheic zone processes on overall stream metabolism. Responding your comment p10, L31 concerning the observed biofilm growth on resin (p11, line 15) “Can this not be eliminated by using a silver treatment as a fixed surface biocide?”

Yes, but it would drastically change the absorbing capacity of the MACROPOROUS resin granulars. Testing different biocides or sterile resins is complex, as for each the complete characterization of the resin behavior has to be repeated and interference with alcohol and nutrient analytics has to be excluded. For this initial study to implement the method, we only assessed the potential importance of biofilm. As outlined in the discussion, ongoing work with HPFM should also tackle this problem.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/bg-2016-334/bg-2016-334-AC1-supplement.pdf

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